

**REMARKS**

Claims 1 -6 and 12 -24 are currently pending in the application. Claims 7 -11 have been canceled without prejudice or disclaimer as drawn to a non-elected invention.

Applicants reserve the right to file divisional applications with claims covering the subject matter of canceled Claims 7 -11. Claims 1, 3, 12, 13, 17, 18, 21 and 22 are objected to.

Claims 4, 5, 14, 15, 19, 20 23 and 24 are rejected under 35 U.S.C. § 112, second paragraph.

Claims 1 -6 and 12 -24 are rejected under 35 U.S.C. § 102/103.

**Amendments**

Applicants have canceled Claims 7 -11.

Applicants have amended claims 1, 3, 12, 13, 17, 18, 21 and 22 to remove the colon after the word "of."

No new matter has been added.

**I. Claim Objections**

The Examiner objected to Claims 1, 3, 12, 13, 17, 18, 21 and 22 because of the presence of a colon after alleged "Markush" language.

Applicants respectfully point out to Examiner that the phrase used in Claims 1, 12, 17 and 21 is "consisting essentially of", and does not designate a Markush group. With respect to Claims 3, 13, 18 and 22, Applicants respectfully submit that they are unaware of any prohibition against the use of a colon in conjunction with a Markush claims. Nonetheless, merely to advance the prosecution of the application, Applicants have removed the colons from the places indicated in Claims 1, 3, 12, 13, 17, 18, 21 and 22.

Reconsideration is respectfully requested.

**II. Rejections Under 35 U.S.C. § 112, second paragraph**

The Examiner rejected Claims 4, 5, 14, 15, 19, 20, 23 and 24 under 35 U.S.C. § 112, second paragraph. Examiner asserts that the term "thiosynergist" is undefined and thus the claims are indefinite. Applicants respectfully traverse this rejection.

Applicants respectfully submit that one having ordinary skill in the art is familiar with thiosynergists and how they function in polyolefins. Applicants therefore respectfully submit that it is not necessary to provide a definition for "thiosynergist" in the specification. For Examiner's convenience Applicants have provided copies of the following references, which discuss thiosynergists: (1) Technical Information for Lowinox DLTDP, from Great Lakes Chemical Corp.; (2) Sterically Hindered Phenols in Production and Processing of PVC, Wegmann *et al.*, see page 2, last paragraph; and (3) The Chemistry and Service of Stabilization, from Great Lakes Chemical Corp., Lee *et al.*, see pages 4 and 11 -13.

Based on the above, Applicants respectfully submit that the term thiosynergist used in Claims 4, 5, 14, 15, 19, 20, 23 and 24 would be recognized by one having ordinary skill in the art and that Claims 4, 5, 14, 15, 19, 20, 23 and 24 are therefore definite. Reconsideration is respectfully requested.

**III. Rejections Under 35 U.S.C. § 102(b)/103(a)**

The Examiner rejected Claims 1 -6 and 12 -24 under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, obvious over U.S. Patent No. 5,925,703 to Betso *et al.* ("Betso"). Applicants respectfully traverse this rejection.

M.P.E.P. § 2131 states that, "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

Furthermore, M.P.E.P. § 2143 states that in order to establish a prima facie case of obviousness three basic criteria must be met. First there must be some suggestion or motivation in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference(s) must teach all of the claim limitations. "The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in the applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 493, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).

Applicants respectfully submit that because Betso does not disclose every element recited in Claims 1 -6 and 12 -24, that those claims cannot be anticipated by or obvious over Betso.

Examiner asserts that he has basis to hold a reasonable belief that Betso inherently discloses the following properties recited in Claims 1 -6 and 17 -20: a propylene/ethylene impact copolymer having an ethylene content of up to 15 percent by weight, and a xylene solubles fraction having an intrinsic viscosity of at least 3 dL/g and a molecular weight (Mw/1000) of at least 350. It is therefore Examiner's position that the burden has shifted to Applicants to demonstrate otherwise, citing *In re Best*, 562 F.2d 1252, 195 USPQ 430 (CCPA 1977), and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980).

Applicants respectfully submit that Examiner has not established inherency of the recited properties in Betso, and has therefore not shifted the burden to the Applicants.

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed Cir. 1993). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present

in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.' Inherency, however, may not be established by probabilities or possibilities. The fact that a certain thing may result from a given set of circumstances is not sufficient." *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (citations omitted). "In relying on a theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990).

Applicants respectfully submit that Examiner has offered no basis in fact or technical reasoning to support his determination that Betso inherently discloses the recited properties. Betso discloses propylene impact copolymers generically, and does not provide any disclosure of specific properties of those polymers. Applicants respectfully point out that the disclosure of an ethylene content of 1.5 to 7 percent refers to random copolymers. See Betso col. 9, Ins. 17 to 19. Nonetheless, as can be seen from Table IX in the instant application, not all propylene/ethylene impact copolymers that have an ethylene content in the range of up to 15 percent necessarily have the intrinsic viscosity and molecular weight (Mw/1000) properties recited in claims 1 -6 and 17 -20. Applicants therefore respectfully submit that Examiner has not established the inherency of the recited properties in Betso.

With respect to Claims 12 -16 and 21 -24, Examiner asserts he has basis to hold a reasonable belief that Betso inherently discloses a propylene homopolymer having a crystallinity of at least about 55 percent.

Again, Applicants respectfully submit that Examiner has offered no basis in fact or technical reasoning to support his determination that Betso inherently discloses the recited property. Betso generically discloses propylene homopolymers, but is completely silent with respect to the crystallinity of those polymers and any other properties tending to affect the

crystallinity of those polymers. Applicants therefore respectfully submit that Examiner has not established the inherency of the recited property in Betso.

Because Examiner has not provided a reasonable basis in fact or technical reasoning why the recited properties are inherently disclosed in Betso, Applicants respectfully submit that Examiner has not established anticipation of Claims 1 -6 and 12 -24 by Betso. For the same reason, Applicants respectfully submit that Examiner has not established a *prima facie* case of obviousness of Claims 1 -6 and 12 -24 over Betso. Reconsideration is respectfully requested.

**CONCLUSION**

Applicants believe that the foregoing amendments and remarks have overcome or rendered moot all grounds for rejection or objection. There being no other rejections or objections, Applicants believe that the application is in a condition for allowance. Applicants therefore respectfully request prompt action on the claims and allowance of the application.

If the Examiner believes that personal communication will expedite prosecution of the application, the Examiner is invited to telephone Applicants' undersigned agent directly.

**AUTHORIZATION**

Applicants believe that no extension of time is required to make submission of this response timely. However, in the event that an extension of time is required, Applicants hereby submit a petition for such extension of time as may be necessary to make this response timely. The Commissioner is hereby authorized to charge the necessary fees to deposit account No. 502194. A duplicate of this authorization is enclosed.

Respectfully Submitted,

BUCHANAN INGERSOLL PC



Matthew P. McWilliams  
Registration Number: 46922

Buchanan Ingersoll PC  
1835 Market  
14th Floor  
1835 Market Street  
Philadelphia, PA 19103-2985  
Ph: (215) 665-3865  
Fax: (215) 769-9929  
**Date: December 13, 2004**

**Customer No. 041068**



## Great Lakes Chemical Corporation

# PA

Business Unit or  
Division

Polymer Additives  
One Great Lakes Boulevard, P.O. Box 2200, West Lafayette, IN 47996-2200

Document Type

## Technical Information

Product Name

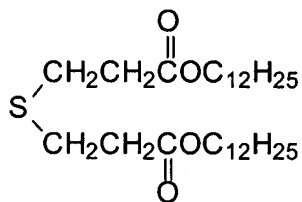
### Lowinox DLTDP

#### Thiosynergist Antioxidant

Lowinox DLTDP is a sulfur containing antioxidant for use during polymer processing.

Di-lauryl-3,3'-thiodipropionate

CAS Reg. Number [123-28-4]



#### Typical Properties

Appearance	White solid
Bulk density (g/ml)	0.50
Molecular weight	515
Specific Gravity @ 70°C, g/ml	0.895
Melting range, °C	38 - 41

#### Thermogravimetric Analysis (10 mg @ 10°C/minute under N<sub>2</sub>)

Weight Loss, %	5	10	25
Temperature, °C	251	250	296

#### Solubility

Chloroform	Soluble	Xylene	Soluble
Diethyl ether	Soluble	MEK	Soluble
Methylene Chloride	Soluble	Toluene	Soluble
Hexane	Soluble	Cyclohexane	Soluble
Water	Insoluble	Alcohols	Insoluble

**Lowinox DLTDP** decomposes and neutralizes hydroperoxides, formed by auto-oxidation of polymers. It is quite often used as a synergist in combination with phenolic antioxidants. It is mainly used in polyethylene, polypropylene, ABS, polyester and polyamide. **Lowinox DLTDP** has been approved for use in some food packaging applications.

The use of proper protective equipment is recommended. Excess exposure to the product should be avoided. Wash thoroughly after handling. Store the product in a cool, dry, well-ventilated area away from incompatible materials. Unless stated, proper storage will permit usage of the product for 6 to 12 months from the date of receipt. For additional handling and toxicological information, consult the GLCC Material Safety Data Sheet.

# **Sterically Hindered Phenols in Production and Processing of PVC**

**Brighton PVC Conference 2002, April 23 - 25**

**Alex Wegmann, Pascal Xanthopoulos**

**Ciba Specialty Chemicals**

**Business Segment Plastic Additives**

**CH-4002 Basel / Switzerland**

## **Abstract**

Phenolic products are widely used throughout the industry dealing with the production and processing of polyvinyl chloride (PVC). Most effective and efficient, as well as having a good toxicological profile, are molecules where the phenolic group is sterically hindered.

In PVC polymerisation reactions, phenolic molecules are used as chain stoppers to terminate the polymerisation, and also as antioxidants to prevent an oxidative degradation of the polymer during the work-up (stripping and drying) in the PVC process.

Methylmethacrylate-butadiene-styrene (MBS) is a frequently used impact modifier for rigid PVC. MBS needs especially efficient protection against the oxidative degradation of its rubber phase. This is optimally guaranteed by a synergistic blend of a hindered phenol with a thiosynergist (e.g. dilauryl-thio-dipropionate "DLTDP").

Plasticizers for flexible PVC used in thermally very demanding applications, e.g. wire and cable, need to be stabilized with phenolic antioxidants against thermal degradation.

In all these applications, formerly used solid antioxidants are now more and more replaced by more efficient, liquid products which also give invaluable advantages of easy handling, dosage, easy emulsification for introduction into aqueous processes, broad registration and food approval status, thereby strengthening PVC's overall position in the market from an environmental point of view.



### 1) Introduction:

Polyvinyl Chloride (PVC) is one of the most important thermoplastic polymers, approximately 25 million tons are produced and processed each year. PVC is extremely versatile, it can be mixed with a variety of other polymers or substances, to modify its mechanical and physical properties, very important among them are, impact modifiers for rigid PVC (e.g. MBS, acrylates), plasticizers for flexible PVC (e.g. phthalates, adipates, trimellitates), pigments, fillers, thermal stabilizers (e.g. salts based on Pb, Ca/Zn, Sn), UV light stabilizers, optical brighteners, biocides, antistats, etc. Hindered phenols are used in the polymerization of PVC resins, of MBS resins, and also for the stabilization of plasticizers.

### 2) Chain-stopper / antioxidant for the PVC polymerisation process:

A good chain-terminator has to stop the polymerization reaction completely, and quench any remaining catalyst residues (radicals), to avoid post-polymerization during the work-up of the resin. This will guarantee less cleaning operations and, thus, a better plant productivity. @IRGANOX 1141 is a liquid blend of two different hindered phenols (figure 1). They differ in the degree of sterical hindrance of the phenol group: one has a partially, the other a fully hindered phenol group. The partially hindered phenol group is considered to be more active in chain-terminating. In comparative tests, @IRGANOX 1141 proved also to be more effective than the unhindered Bisphenol A (BPA) as chain-terminator for suspension-PVC, which makes up for approximately 85% of the total world-wide PVC production. The smaller the pressure drop after adding the chain-terminator, the higher the efficiency (see figure 2).

The dehydrochlorination test (figure 3) demonstrates that @IRGANOX 1141 is also more efficient than BPA in protecting PVC under thermo-oxidative conditions (antioxidant), as they are common during the stripping and drying process. Moreover, the liquid supply form ensures easy handling, storing, and dosing. There are no dust problems, nor organic solvents or carriers needed. The product is also very easy to emulsify, and it can, therefore, be added to the aqueous process either as emulsion or, alternatively, as straight liquid. There is no weight loss of @IRGANOX 1141 detected by TGA (thermo-gravimetric analysis) in the temperature range relevant to the PVC polymerization, stripping, and drying, i.e. up to 150°C.

### 3) Polymerisation of MBS

MBS is produced, similarly to ABS, by emulsion copolymerisation of a rubber (polybutadiene or styrene-butadiene-rubber) together with styrene and methylmethacrylate. The MBS copolymer is separated from water by coagulation, centrifugation and drying. MBS has a large internal surface area (because its particles are very small) and contains a high amount of unsaturated rubber (up to approximately 80%). Therefore, it is very prone to oxidation in the drying step in presence of oxygen, and needs extremely efficient thermal protection.

The market requirements for antioxidants for MBS are: give very good thermal stability to the MBS resin powder, heat stability of compounded PVC formulations, improved handling of the additive, better cost/performance, easier preparation and better storage stability of antioxidant emulsions.

State of the art have been solid, fully or partially hindered phenols, like @IRGANOX 1076 or @IRGANOX 245 in emulsified form, together with thiosynergists, like DLTDP (dilauryl-thio-dipropionate) or DSTDP (distearyl-thio-dipropionate). Here also, the liquid supply form of @IRGANOX 1141 is a big advantage. It is easy emulsifiable, and the emulsion can be stored at room temperature without problems. Figure 4 shows that @IRGANOX 1141 is even better in thermal stabilization than other hindered phenols, and it also improves the performance of PVC in the milling test (figure 5).

#### 4) Antioxidants for plasticizers:

Only for thermally very demanding applications, like flexible PVC for wire & cable or automotive interior, plasticizers need to be stabilized with antioxidants, in other cases this is not necessary. The main purpose of the antioxidant is to protect the plasticizer in the PVC formulation against thermal oxidation during the processing, as well as during the manufacturing, and the life time of the finished article. In presence of oxygen, tertiary carbon atoms in the plasticizer can form peroxy radicals and peroxides that can decompose under chain scission to form, ultimately, low molecular weight acids that have no more plastifying effect (see figure 6). The antioxidant, in combination with traditional heat stabilizers (e.g. salts containing Sn, Pb, Ca/Zn), also helps to protect the PVC to a certain extent against dehydrochlorination. This is also important because hydrogen chloride released during the thermal dehydrochlorination of PVC can further accelerate the decomposition of the plasticizer.

Whereas for the PVC polymerisation, BPA is only one of many products that are used (others include: hindered phenols, sodium nitrite, acetone-thiosemicarbazone, etc.), for the stabilization of plasticizers it up to now clearly dominates the market.

For practical reasons, and to ensure a homogeneous distribution, the antioxidant is usually added to the plasticizer. Important requirements the antioxidant has to fulfill: Miscibility, compatibility, and good solubility in the plasticizer. Low volatility (little weight loss during thermal aging), and no fogging tendency. Retention of mechanical properties (tensile strength, elongation), no discoloration, and low hydrogen chloride release under thermo oxidative conditions.

In the so-called "Congo-Red-Test" (DIN VDE 0207 part 614), a good measure for the efficiency of an antioxidant, IRGASTAB® PVC 11, based on very similar chemistry as @IRGANOX 1141, shows a similar performance as BPA or @IRGANOX 1076, whereas BHT is clearly inferior (see figure 7). The clear advantage of IRGASTAB® PVC 11 is the liquid supply form that renders it well soluble in plasticizers, compared to solid products, and makes its handling and dosing very easy. The weight loss in a PVC compound (14 days/ 140°C) is comparable to BPA, at approximately 5%. The antioxidant, however, can also be added by the PVC compounder to the PVC formulation, in this case a solid supply form is preferred. IRGASTAB® PVC 86 fulfills this requirement, and is also very effective in the "Congo-Red-Test".

#### 5) Regulatory issues:

Lately, BPA has come under strong pressure because of its alleged endocrine modulating properties ("estrogen mimic"). Therefore, the PVC industry in Western Europe has recently made the decision to phase-out BPA in PVC manufacturing, by the end of the year 2002. Depending on the actual recipes, the amount of BPA in PVC compound formulations, needed for the stabilization of the plasticizer, is approximately 10 times higher than the amount coming from the polymerization step. Therefore, the phase-out of BPA in PVC resins will remain of limited practical value, as far as the concentration of BPA in the final PVC article is concerned, as long as BPA is still used in plasticizers. Nevertheless, it is a first step and clear signal that the PVC industry is determined to use additives which strengthen the image of PVC from an environmental point of view, and contribute to a sustainable future of this polymer.

Investigations have shown that @IRGANOX 1141 and @IRGASTAB PVC do not show endocrine modulating properties. Besides, the products have a very favourable toxicological profile, and are registered world-wide. They have FDA approval for rigid PVC (0.04%), as well as for flexible PVC (0.03%), in PVC films thinner than 1 mil (= 2.5mm), for aqueous and acidic food. In Europe, the components of @IRGANOX 1141 are approved in all plastics up to a SML of 1mg/kg food (CGX AO 145), respectively 6 mg/kg food (@IRGANOX 1076).

## **6) Conclusions:**

Liquid, partially hindered phenols are very effective chain-stoppers and antioxidants in PVC polymerisation, as well as excellent thermal stabilizers for MBS and PVC plasticizers. The liquid supply form makes the handling and dosing very easy. The good toxicological profile renders the products safer to handle, and enables their global broad food approvals.

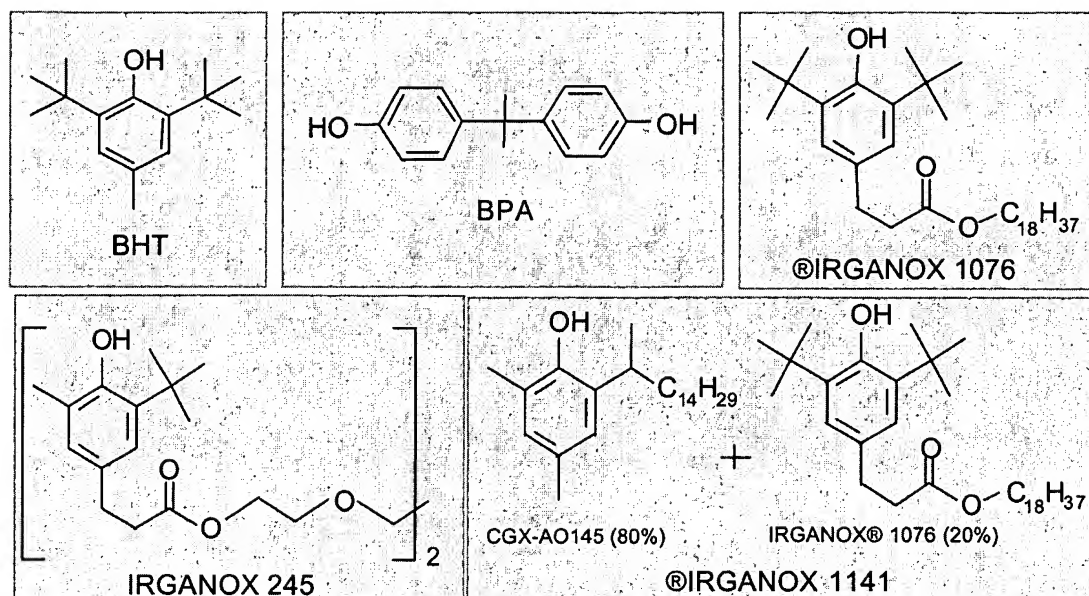


Figure 1: Chemical structures of chain stoppers / antioxidants

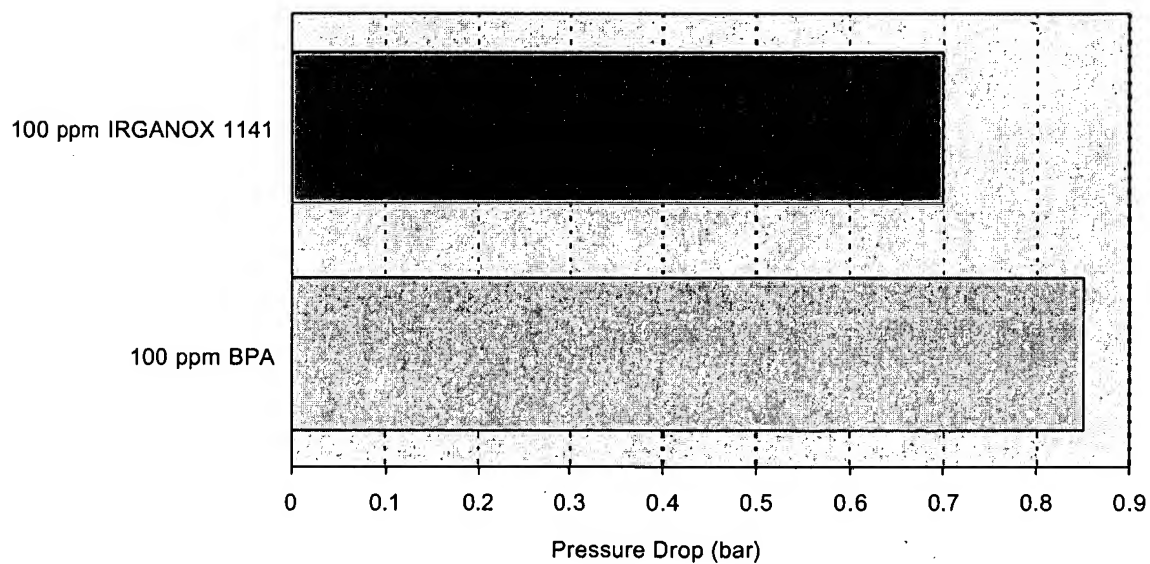


Figure 2: Efficiency of chain stoppers

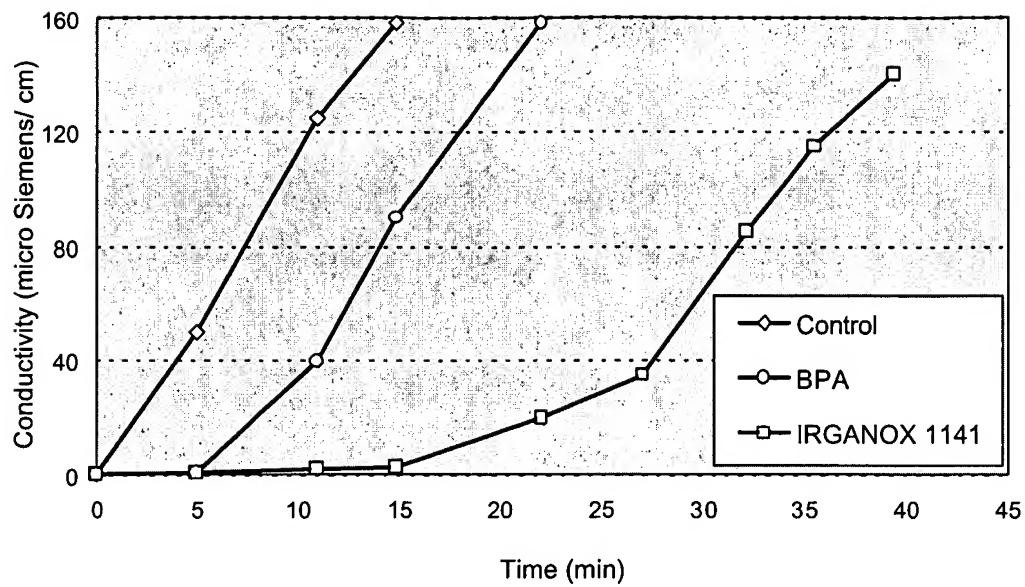


Figure 3: Dehydrochlorination of virgin PVC resin

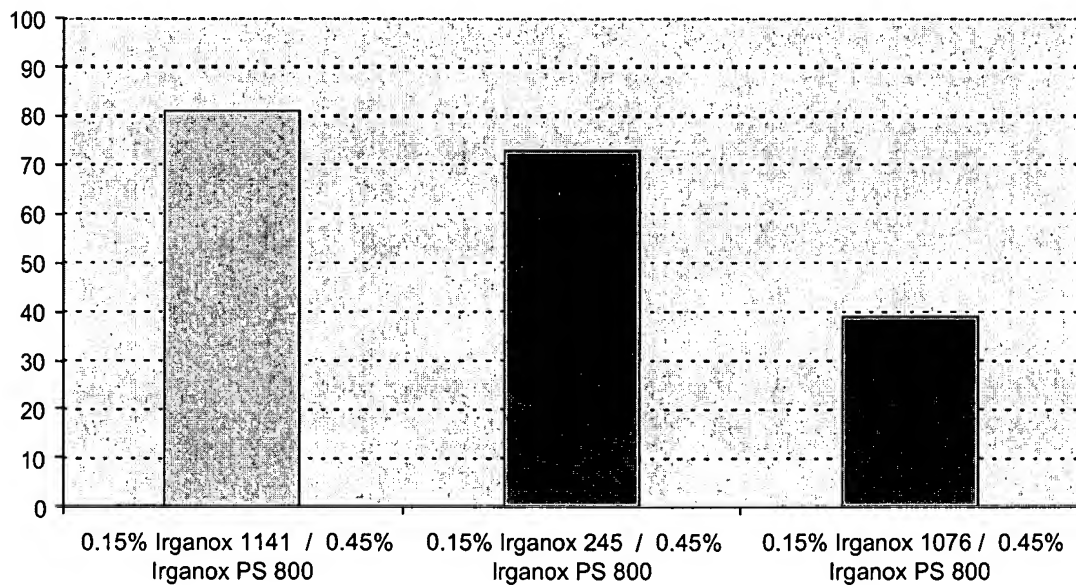


Figure 4: Thermal stability of MBS measured by DSC at 180°C, under oxygen (isothermal method) (@IRGANOX PS 800 = DLTDP)

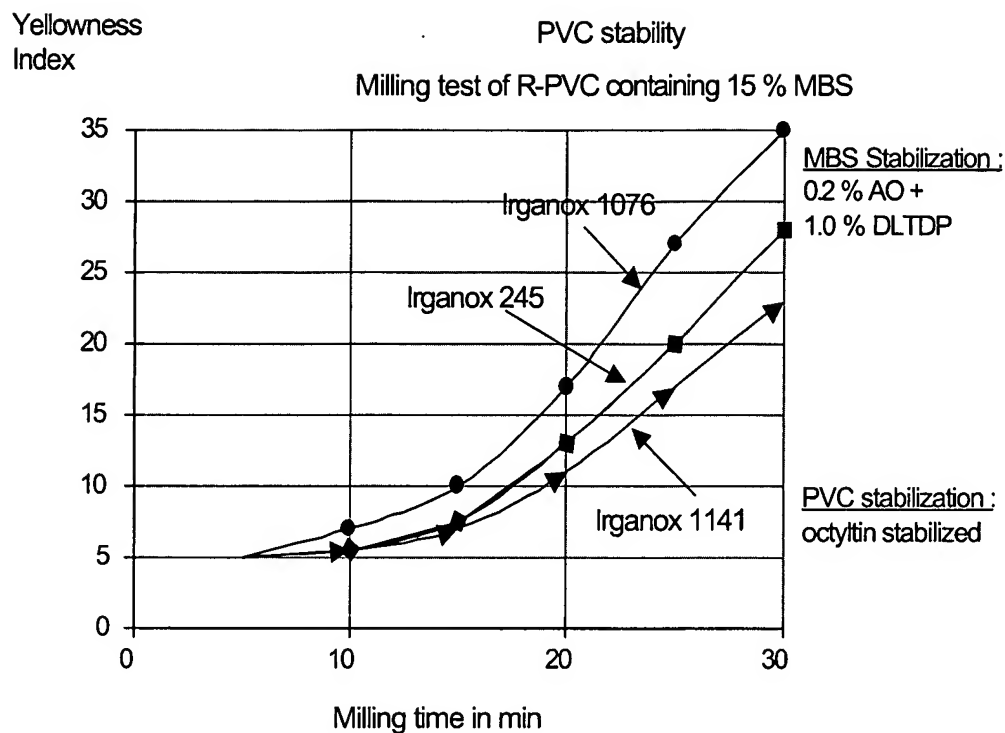


Figure 5: Thermal stability of PVC by milling test at 180°C

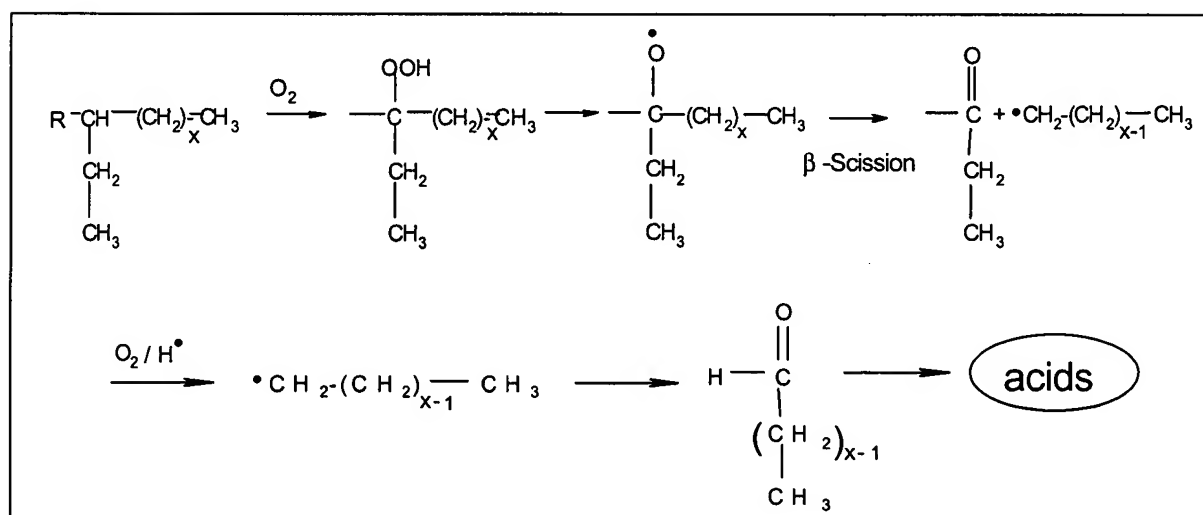


Figure 6: Mechanism of thermal degradation of plasticizers

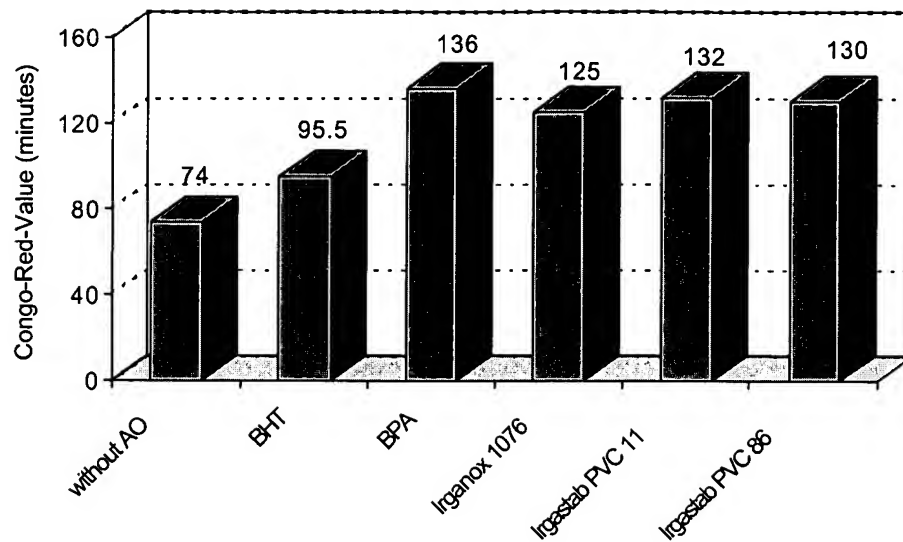


Figure 7: Performance of antioxidants in plasticizer formulations (PVC Cable Application)

PVC Sheathing Formulation:

(Lab Test: Congored DIN VDE 0207 part 614)

PVC	100	phr		
DIDP	52	phr	Pb stabilizer	4.5 phr
Filler	50	phr	AO	0.3 phr



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# **The Chemistry And Service Of Stabilization**

**Dr. Robert E. Lee,**

**Dr. Elisabeth Papazoglou,**

**Dr. Brian Johnson, Dr. J. W. Kim**





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# **Abstract**

## **Rapid Growth of Additive Blends Highlights Additive Interactions That Effect Performance.**

**Specific Examples of Synergistic and  
Antagonistic Interactions Are  
Looked at.**

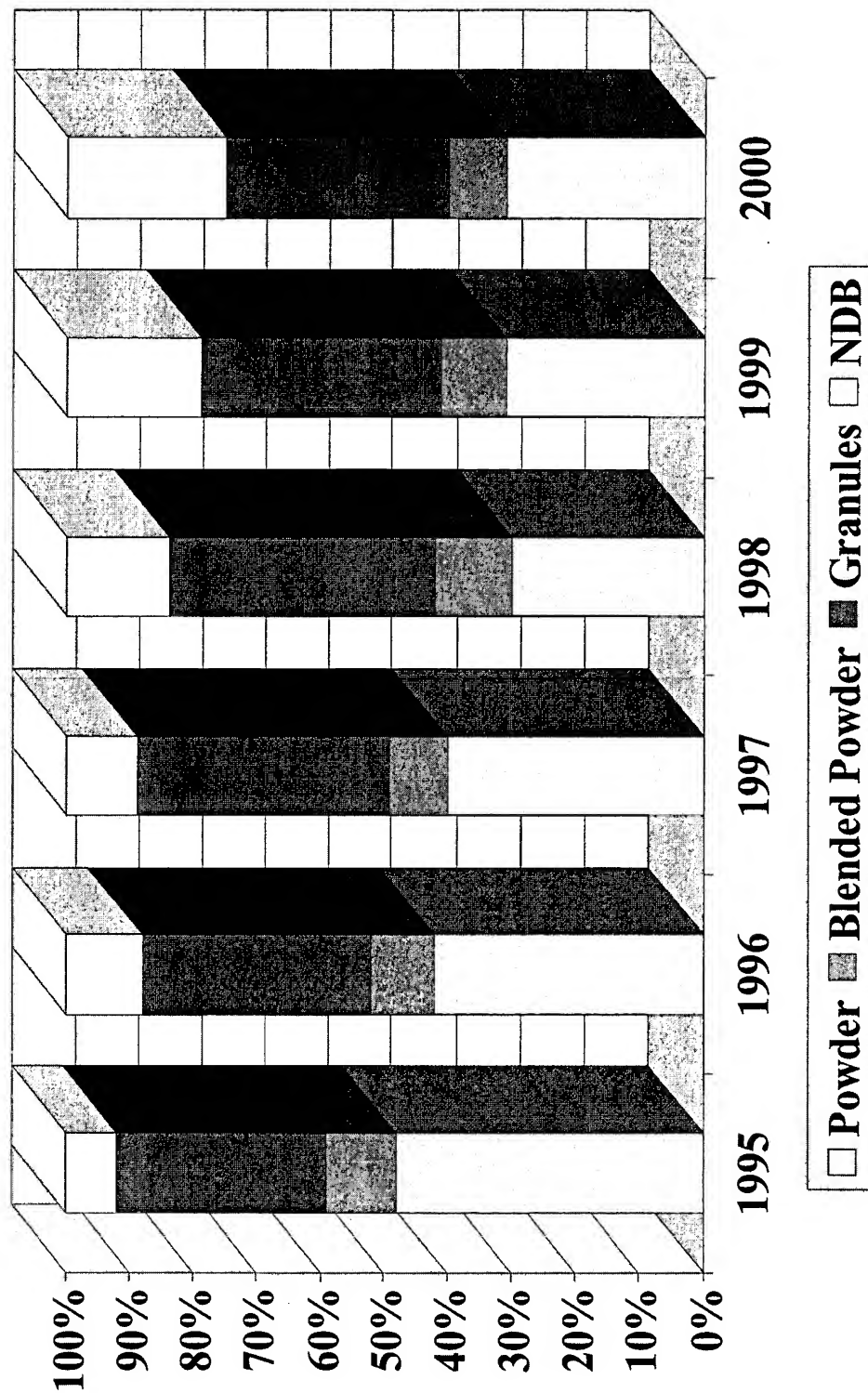


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# Our Trends in Physical Forms





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# **Outline**

- 1) PHENOLIC-PHOSPHITE SYNERGISM
- 2) HALS&THIO-SYNERGIST ANTAGONISM
- 3) PHENOLIC-HALS INTERACTIONS
- 4) PHOSPHITE-ACID SCAVENGER  
INTERACTIONS
- 5) "ALLOY EFFECTS" OF COADDITIVES
- 6) DISPERSION OF NON-MELTING  
ADDITIVES BY COADDITIVES

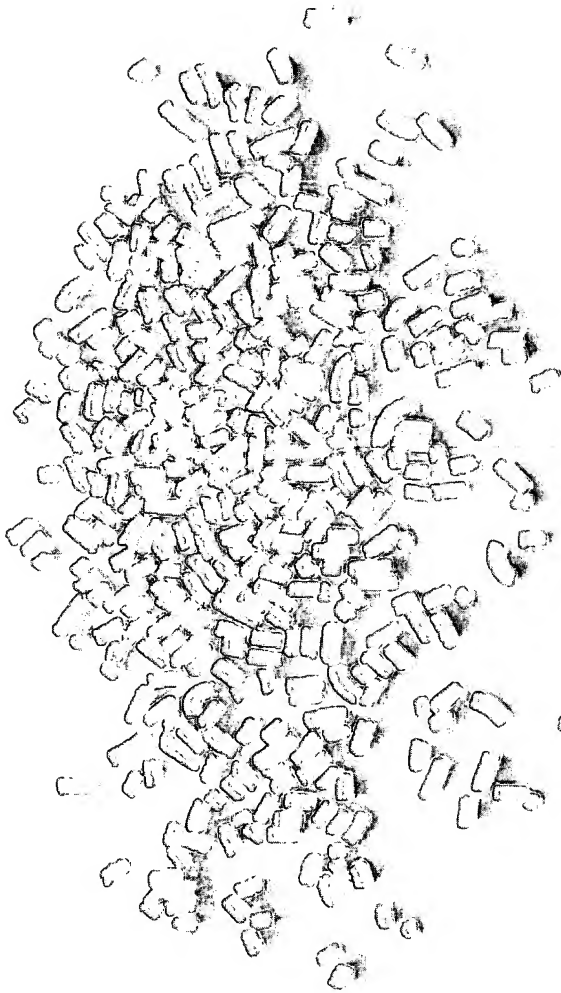


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## No Dust Blends





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# **Concern for Interactions**

- **Rate of something bad happening**  
**“RXN” =  $k[A][B]$  where  $k$  is a rate constant and  $[A]$  and  $[B]$  are concentrations.**
- **In Polymer  $[A][B] = 0.000001$**
- **In a Blend  $[A][B] = 0.25$**
- **250,000 increased rate of “RXN”**



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# **1) Phenolic-Phosphite Synergism**

- **Phenolics are radical traps and function as primary antioxidants**
- **Phosphites are hydrogen peroxide decomposers and function as secondary antioxidants**
- **Combined they are more efficient than their sum. “Synergistic”**

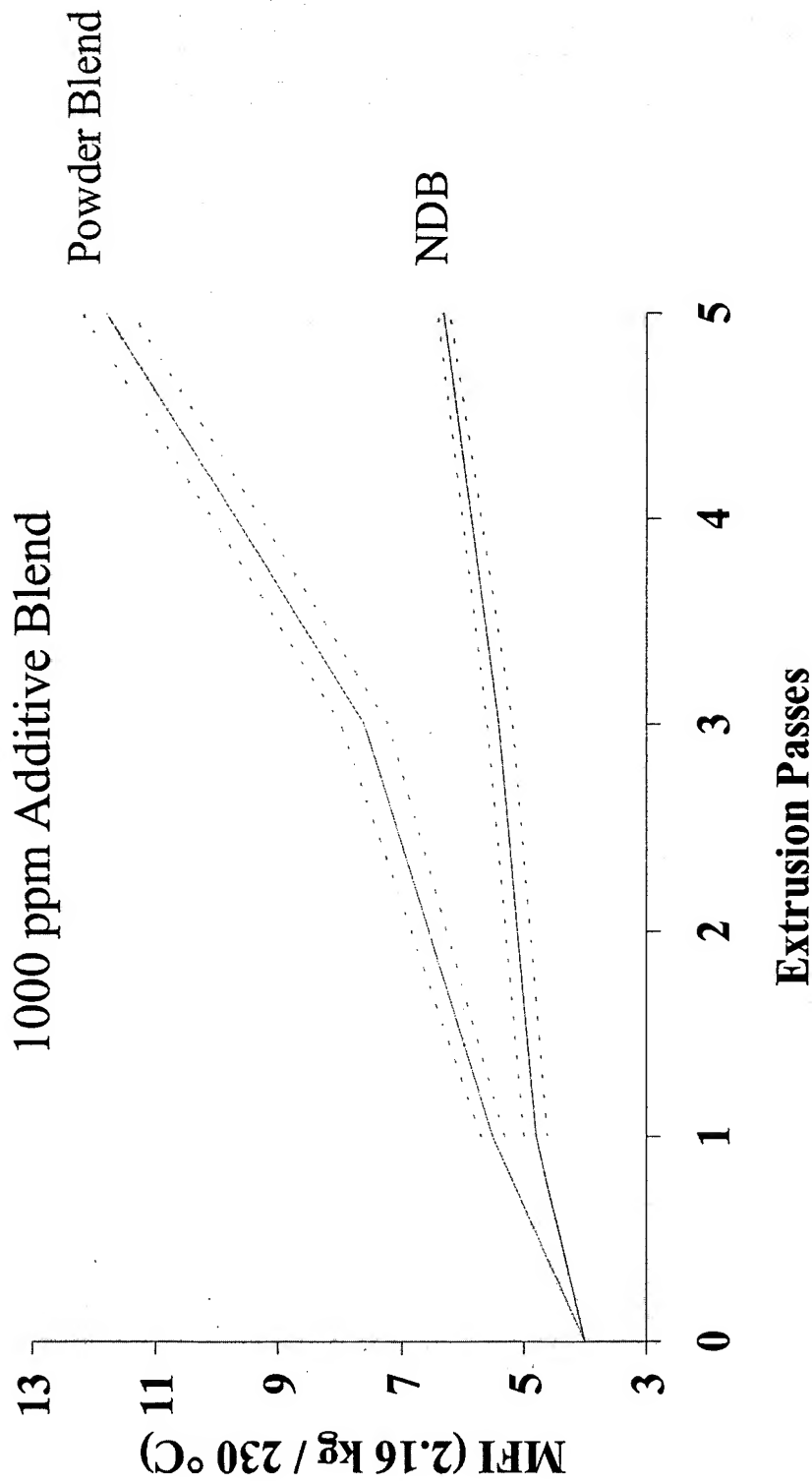


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# Additives

## MFI Stability of Powder Blends & NDB's



- NDB gives better performance - MFI & Standard Deviation
- Factors: Homogeneity, controlled feeding and better dispersion

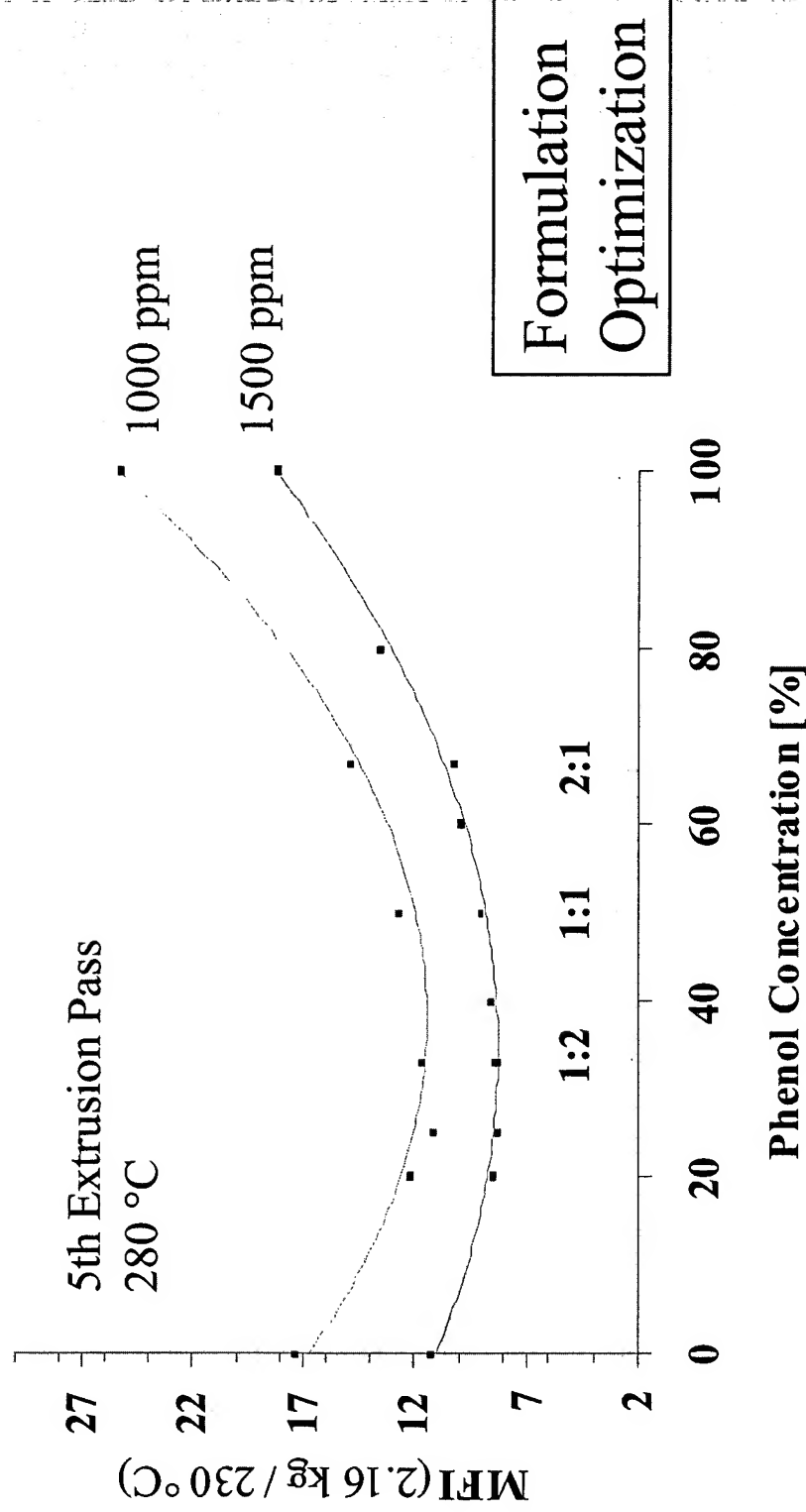


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# Additives

## MFI Stability of Powder Blends & NDB's Effect of Homogeneity of Additive Blend



Reference: J.R. Pauquet, W.O. Drake & R.V. Todesco; Optimizing Processing Stability of Polyolefins; 1993





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# **Phenolic-Phosphite Synergism**

- **Blends Prove Better than  
Separate Components.**



## **2) HALS & Thio-synergist Antagonism**

- **HALS are primary antioxidants with a cyclic mechanism and are typically alkaline in nature.**
- **Thiosynergist like DSTDP are secondary antioxidants which may generate acidic by-products.**
- **Lower UV performance has been observed with the combination.**



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# HALS & Thio-synergist

Formulation PP fiber with Br- FR & HALS	Exposure to 50% retained Tensile Dry Xenon Test	Exposure to 50% retained Tensile Wet Xenon Test
System A & No DSTD P	2200kJ/m <sup>2</sup>	1175kJ/m <sup>2</sup>
System A & 30ppm DSTD P	2275kj/m <sup>2</sup>	1100kJ/m <sup>2</sup>
System B & No DSTD P	1650kJ/m <sup>2</sup>	1050kJ/m <sup>2</sup>
System B & 30ppm DSTD P	1720kj/m <sup>2</sup>	1030kJ/m <sup>2</sup>



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## **HALS & Thio-synergist**

- **Instead of acid-base interaction which should always be bad, blooming of DSTDP may be bring the HALS to the surface for synergistic effect when dry and antagonistic when wet exposure occurs.**
- **No Harmful Impact from Blends.**



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## **3) Phenolic- HALS Interactions**

- Color Development is Greater  
When Phenolic AO's & Hindered  
Amine Light Stabilizers are  
together (Especially secondary  
HALS).**

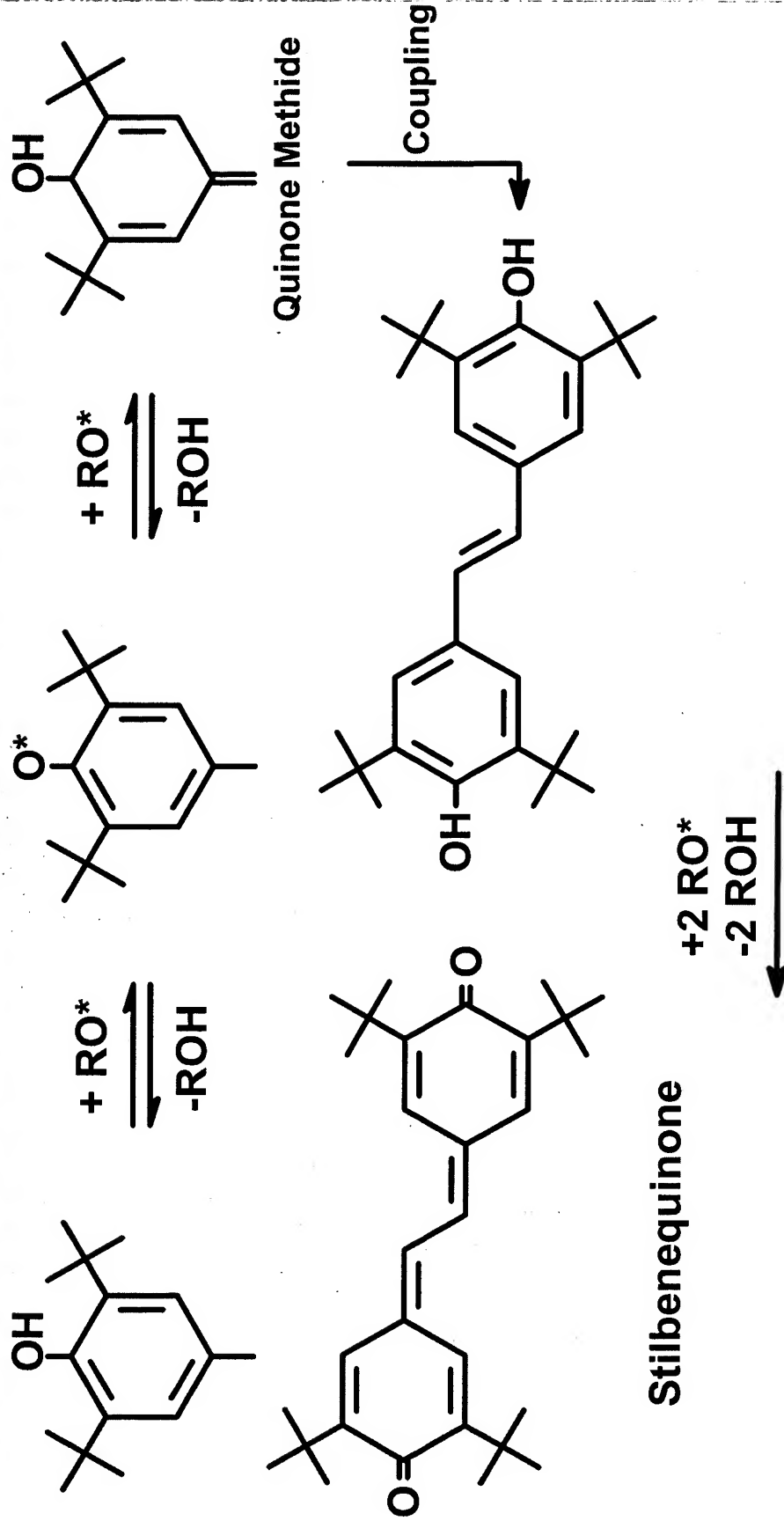


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# Phenolic Color Formation

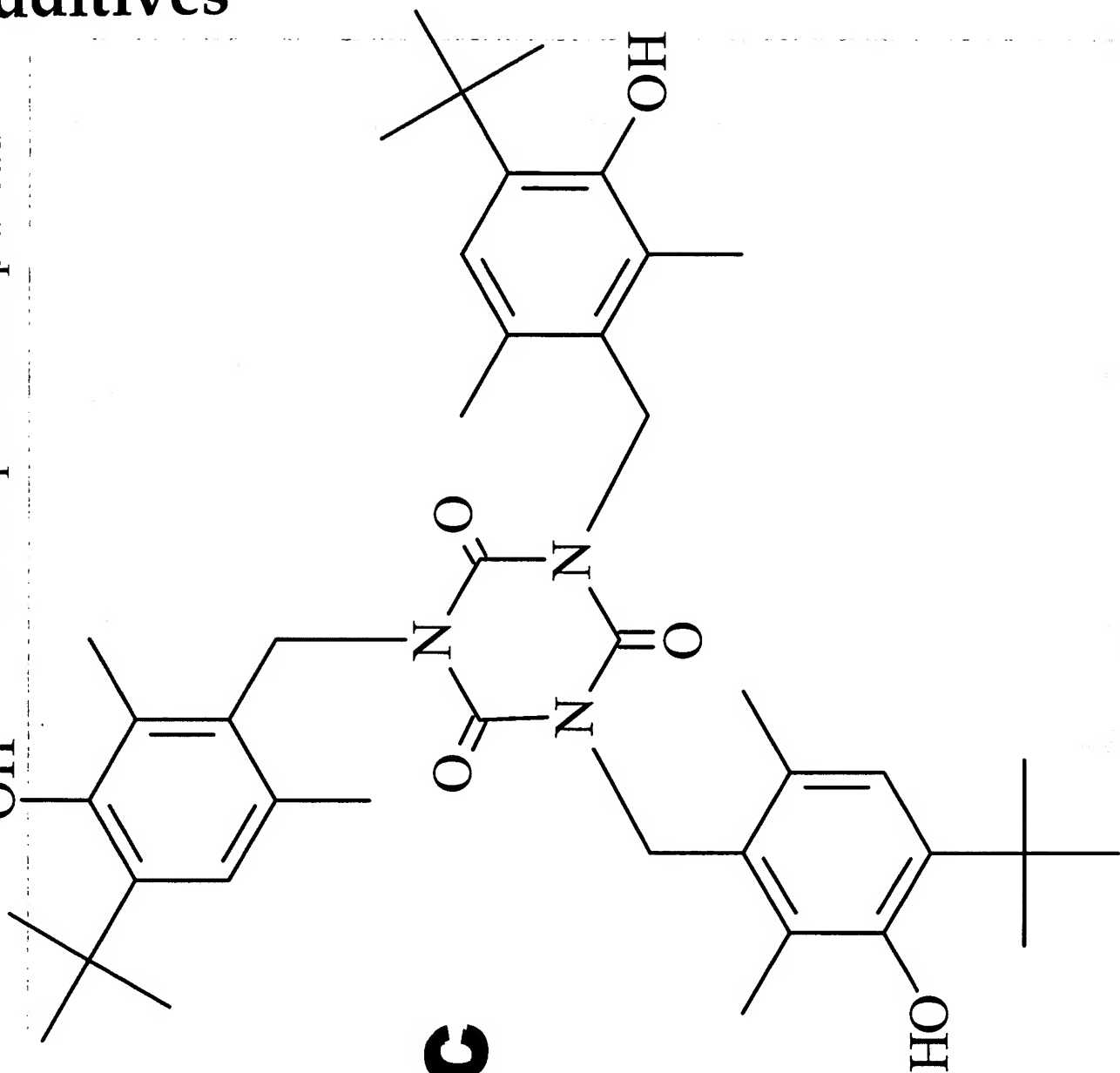




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**Phenolic  
1790**

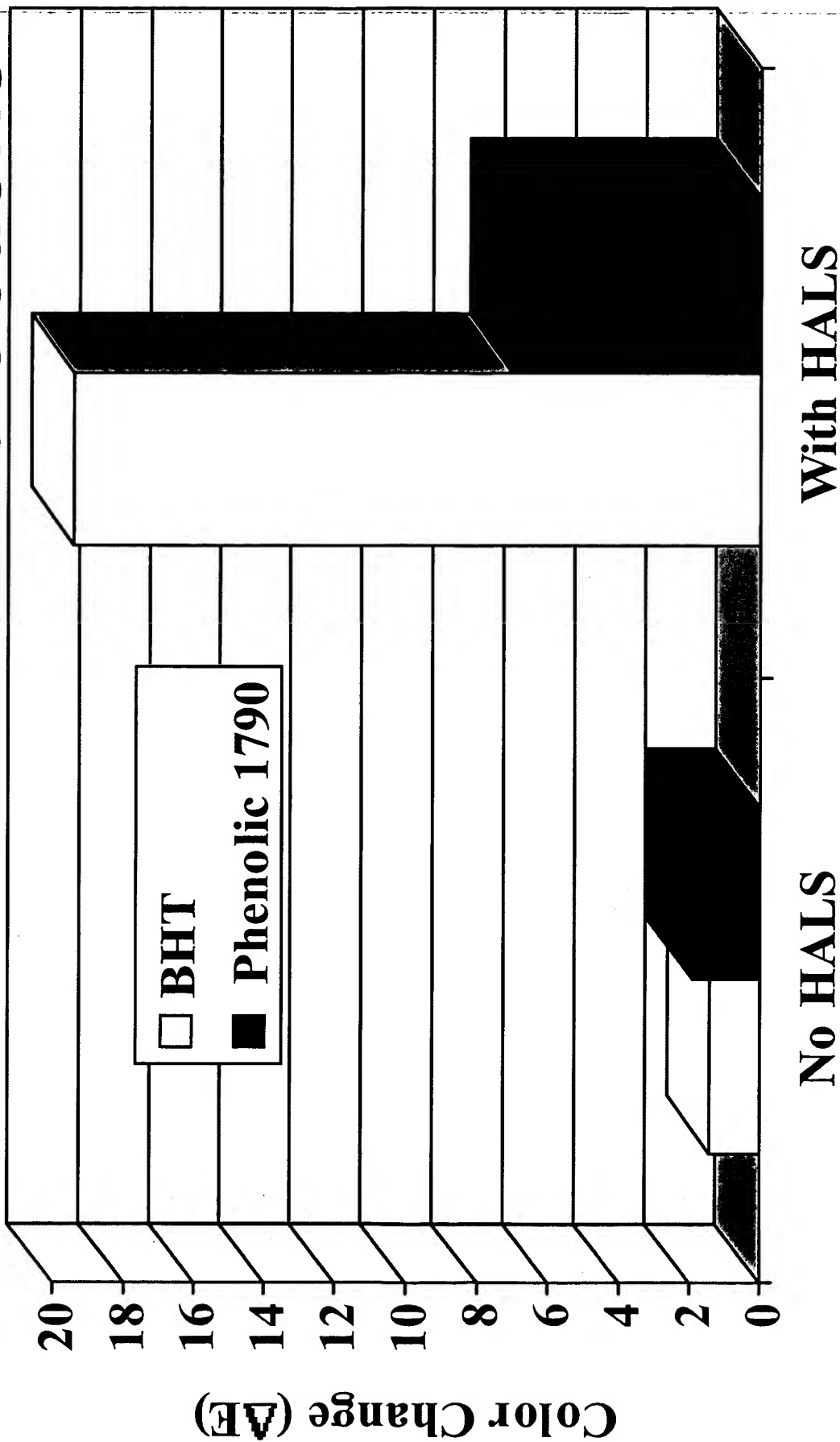


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# Phenolic- HALS Interactions







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# **Phenolic- HALS Interactions**

- **HALS Worsen Existing Problem.**
- **BLENDS can Hurt Performance.**
- **Alternate Formulations Help.**



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## **4) Phosphite- Acid Scavenger Interactions**

- **Hydrolysis is the Weakness of  
Most Phosphites-Handling  
Problem.**
- **Generally Acid Catalyzed Reaction**
- **Acid Scavengers Should Help.**
- **Additive Water Should Hurt.**



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# Additives

## *Hydrolysis of Phosphite*

### *Impact of Co-additives on Hydrolysis*

"Speed" of Hydrolysis

Slower

Neutral

Faster

Hydrotalcite

ZnO

$\text{Na}_2\text{CO}_3$  (?)

$\text{CaCO}_3$  (?)

Erucamide/Oleamide

HALS

Talc (?)

GMS

PO-waxes

Ca-stearate

Na-benzoyl

TIPA

Zn-stearate

increased alkalinity

decreased (molar) ratio  $\text{H}_2\text{O}$  to phosphite

increased (molar) ratio acid scavenger/hydrotalcite to phosphite



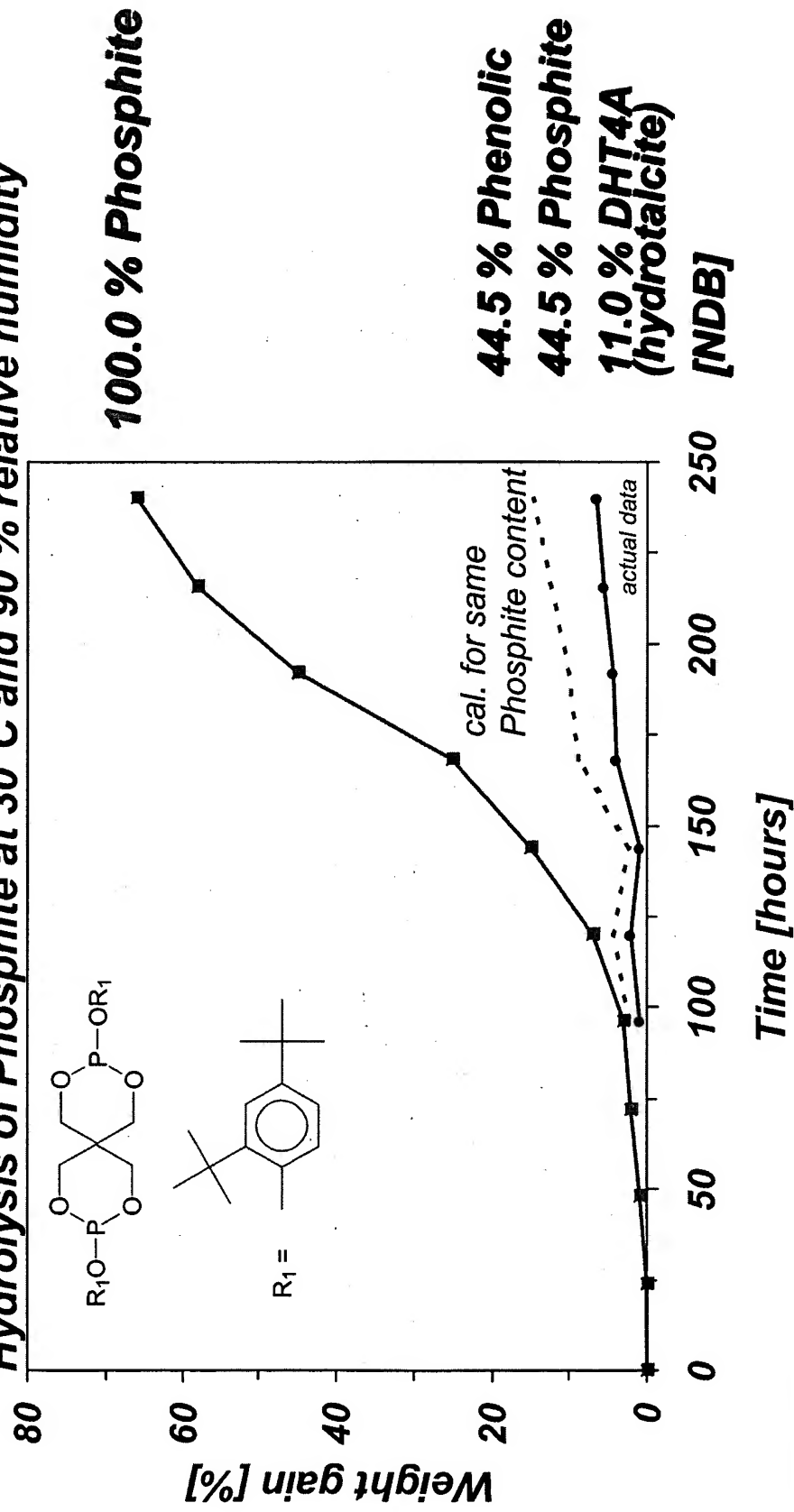
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# Additives

## Impact of Co-additives on Hydrolysis

**Hydrolysis of Phosphite at 30°C and 90 % relative humidity**



Reference: G. Harm, J. Wittenauer, P. Roscoe; ADDITIVE '95, Clearwater Beach, FL



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**Additives**

- Phosphite-**  
**Acid Scavenger**
- **Dry Scavengers Blends Help.**
  - **“Wet Blends” Questionable.**



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## **5) “Alloy Effects” Of Coadditives**

- **DSC Shows that Blends Often  
have Suppressed Melting Points.**

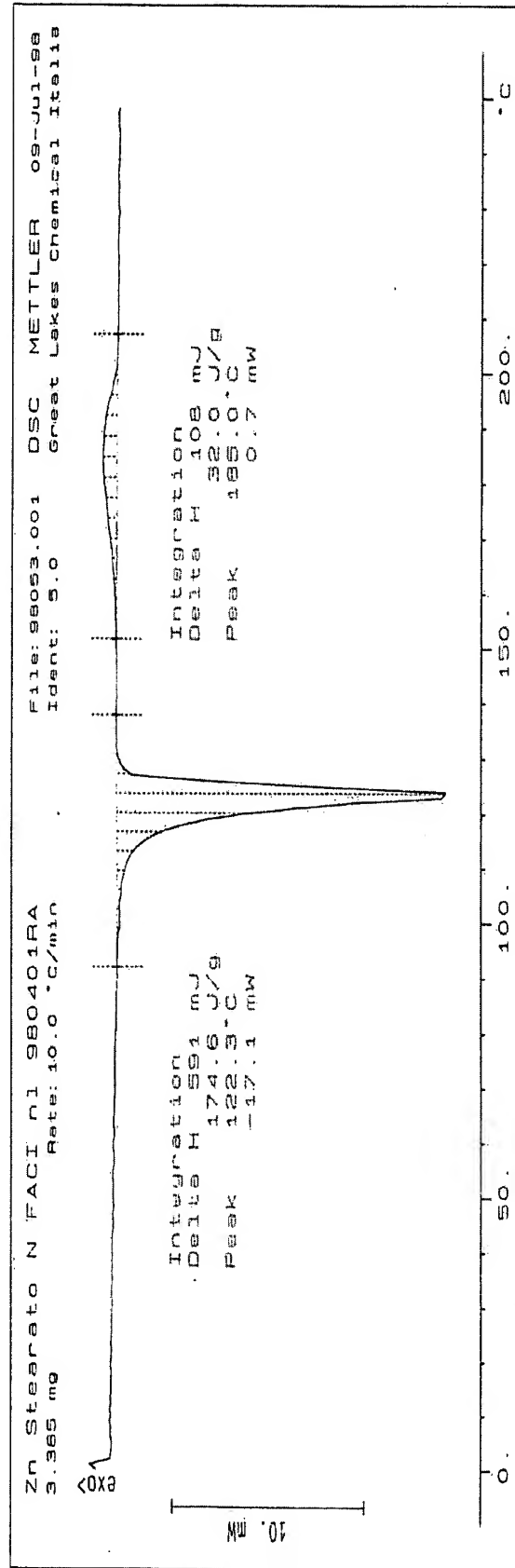


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# Zinc Stearate



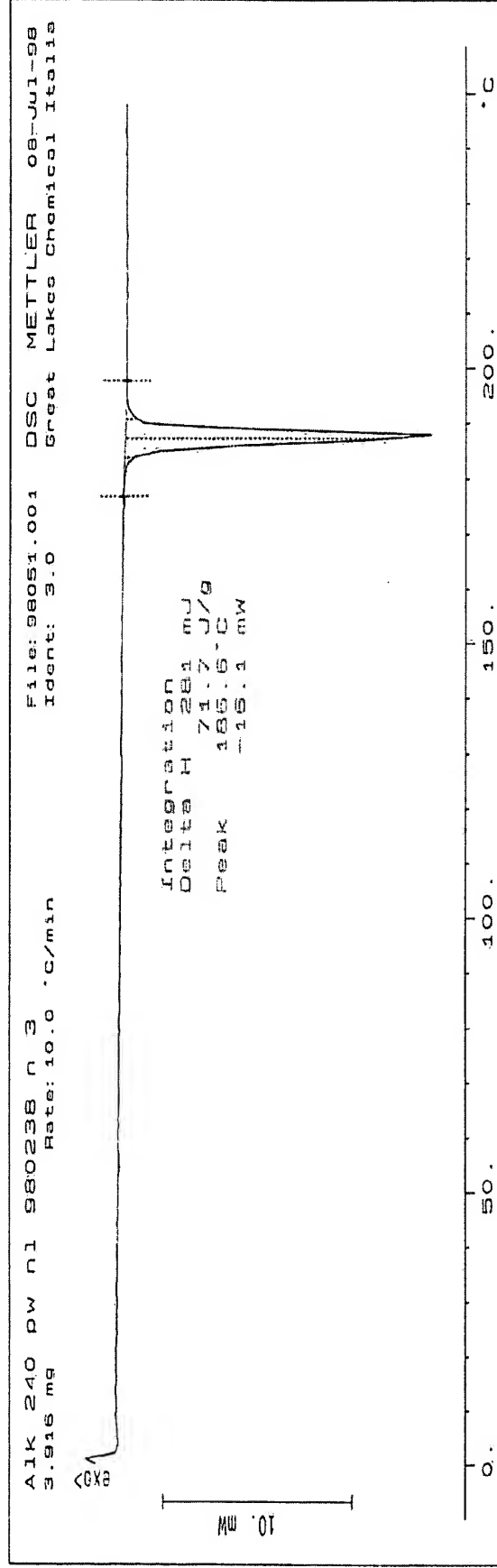


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# Phosphite





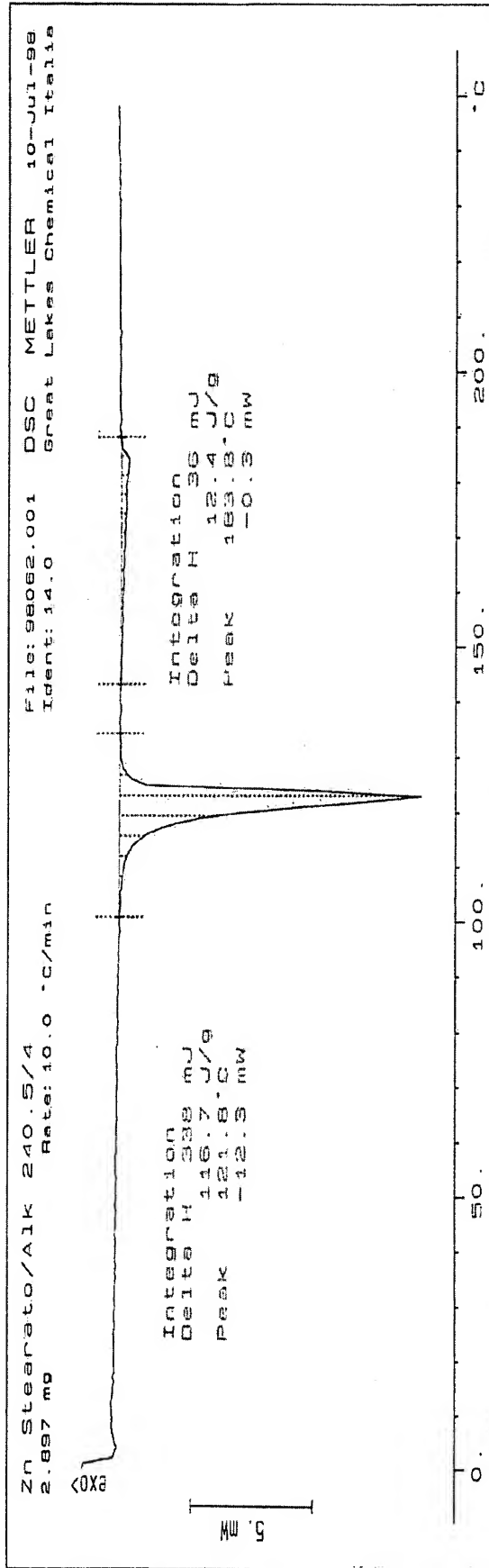


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# Zinc Stearate & Phosphite



121.0 C



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# **“Alloy Effects” Of Coadditives**

- **Blends Improve Introduction of Components Through Apparent Melting Point Reduction.**



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## **6) Dispersion Of Non-melting Additives By Coadditives**

- **Non Melting Additives Like Clarifiers are Pelletized to Avoid Dust and Improve Feeding.**
- **Agglomerations Appear as Specks.**
- **Pre-dispersion in Blends Help.**



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## Additives

# 6) Dispersion Of Non-Melting Additives

Additive Physical Form	Feeding Attributes	Performance Attributes
Powder	-	+
Pellets	+	-
No Dust Blends	+	+



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# Conclusions

- Stabilizer Blends Are Popular
- Chemical and Physical Interactions Occurring
  - Phenolic-Phosphite **RATIO DEPENDENCE Synergism**
  - HALS-Thiosynergist **WET Antagonism DRY SYNERGISM**
  - Phenolic- HALS “Color” **GAS FADE** Interactions
  - Phosphite-Acid Scavenger **HYDROLYSIS** Interactions
  - “Alloy Effects” **LOWER** Melting Points of Coadditives Blends
  - Dispersion **PRE-DISPERSION** of Non-melting Additives
- Challenging Chemistry With Service of Stabilization



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**Additives**

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